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Upgrading Existing Wastewater Treatment Plants Pre-Plant Considerations

Johnson and Anderson, Inc, Pontiac, Mich

Prepared for

Environmental Protection Agency, Cincinnati, Ohio Office of Technology Transfer

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UPGRADING EXISTING WASTEWATER TREATMENT PLANTS
PRE-PLANT CONSIDERATIONS

prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY

TECHNOLOGY TRANSFER DESIGN SEMINAR

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CHICAGO, ILLINOIS

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Many communities are experiencing population growth and increasing demands for additional commercial and industrial facilities. Also, most treatment plants are being required to meet revised effluent criteria to satisfy federal and state stream quality standards. These conditions are causing communities to review existing treatment facilities and determine the most economical means for upgrading their ability to treat larger wastewater flows and produce a higher quality effluent.

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Reasons for Upgrading

Many communities are experiencing population growth and increasing demands for additional commercial and industrial facilities. Also, most treatment plants are being required to meet revised effluent criteria to satisfy Federal and State stream quality standards. These conditions are causing communities to review existing treatment facilities and determine the most economical means for upgrading their ability to treat larger wastewater flows and produce a higher quality effluent.

Collection Systems

Before an evaluation is made of the various existing wastewater treatment units, a detailed analysis should be made of the collection system. In many cases improvements to the sewers are relatively inexpensive as compared to equivalent improvements and additions to the treatment units. Of course the main culprit is storm water, either by direct entry or by infiltration - coming from broken and separated pipe joints, broken and poorly constructed manholes, manholes built in storm ditches, poor house lead connections, roof drains, and footing drains connected to sanitary sewers. Maintenance methods such as the use of T.V. inspection and remote grouting and guniting manholes are well known; however, few communities can afford a complete rehabilitation of their entire sewer collecting systems in a reasonable length of time. Therefore the worst sections should be first selected for improvement. This is much easier to say than to do!

Wastewater Flow Measurement

Measuring flow in sewers is theoretically an easy task. When you attempt to find equipment, you'll find that there are many expensive devices for permanent installation and little information on portable equipment. Most of the equipment depends upon a free fall condition downstream of the metering device. To adequately monitor significant

sewer systems you should have a variety of devices such as vee-notch weirs, 12 inch to 60 inch, which will fold to pass through manhole openings, and pneumatic or electrical level indicators with respective portable flow recorders. A collection system which has several key lift stations can be monitored by installing clocks which record total operating time, and event recorders to display the distribution of pump operations. Surcharged sewers can be monitored by using a metered quantity of salt and a recording conductivity meter immediately downstream.

Definitions of Wastewater Flows

When discussing wastewater flows, it is necessary to accurately define the flow parameters you are using. There are various flow allocations used in sewer and treatment plant design that are often confused. In the design of sewer lines you must provide sufficient capacity for peak loads even though they are short lived. However, the treatment capacity of wastewater treatment plants is expressed as average daily flows. To add to the confusion sewer design capacity is generally referred to in units of cfs (cubic feet per second) and plant design capacity is generally referred to in units of MGD (million gallons per day) and pumps are referred to in units of gpm (gallons per minute).

When discussing or presenting a report concerning an overall collection and treatment system to members of a local unit of government, you should make clear the various distinctions. This is also true for consulting engineering firms and government agencies. To aid in your work the following table and list of relationships will be helpful:

1 cfs = 0.645 MGD

1 cfs = 450 gpm

1 MGD = 1.55 cfs

Average Daily Flow - The average flow for a twenty-four hour period and the average daily flows for a month's period.

Daily Peak Flow - the peak flow which is expected to occur within a twenty-four hour period. Diurnal flow curves show the peak hourly flow in municipal systems to be approximately 140% of the average daily flow.

Yearly Peak Flow - the highest average daily flow for a twenty-four hour period recorded within a twelve month period. Many communities (not all) experience a yearly peak flow at 2.5 times the average daily flow for a twelve month period.

Normal Residential Water Use and Sewage - usually calculated at 100 gallons per person per day or 350 gallons per single type household unit per day and 250 gallons per multiple type household unit per day. When calculating anticipated revenue, it is generally advisable to calculate water sales (which most sewage rates are based) upon 75 gallons per person per day.

Trunk Sewer Capacity - often calculated at 0.4 cfs per 1000 people, or approximately 250 gallons per person per day which is 2.5 times average daily flow. This reflects the sewer's ability to accommodate yearly peak flows.

Lateral Sewer Capacity - usually based on a calculated ratio of maximum to average flow. The ratio can vary from 5 for small systems to 2.5 for larger systems.

Flow Equalization

There are several advantages in the use of flow equalization facilities. They can level peak flows in existing collecting sewers thereby extending the use of the sewers. They are normally sized to level normal twenty-four hour variation (diurnal) where the maximum is approximately 140% of the daily average flow; however, they can be sized to accommodate yearly peak flows and located strategically throughout a collection network.

Equalization basins located near or at a wastewater treatment plant will aid in maintaining steady-state influent conditions. Settling efficiencies, biological activity, chemical reactions, disinfection and filtration runs can all be optimized when flows and concentrations of the influent are normalized. Most equalization basins are designed to accommodate only the quantity in excess of average flow. This has a positive impact upon treatment because it maintains design retention times. However, there will be a far greater impact when all influent flows are passed through an equalization basin. The high concentrations of biological matter do not correspond to the high periods of flow. These are experienced during early morning, mid-noon and late evening flow periods; whereas, the major flows to the equalization basin occur from approximately 10:00 a.m. to 5:00 p.m. Similarly high phosphorous loadings occur during the 10:00 a.m. to 2:00 p.m. period. The continuity of consistant effluent quality is dependent upon a balanced influent. There is little data now available to determine the exact impact of equalization. A total pass-through equalization unit with aeration can be expected to classify grit solids, initiate biological reductions, and provide a balanced loading on subsequent systems.

Existing Plant Evaluations

Before proceeding with the design and drawing of new treatment facilities you should first prepare a progress flow diagram. This diagram should display the following information:

1. Influent flows and concentrations.
2. Each treatment unit with its size and design criteria.
3. A comparison with the existing standards such as "10 States Standards".
4. Concentrations of SS, BOD, P and NH_4-N as the flow leaves each unit.
5. Pumping rates of sludges and chemical feeds.

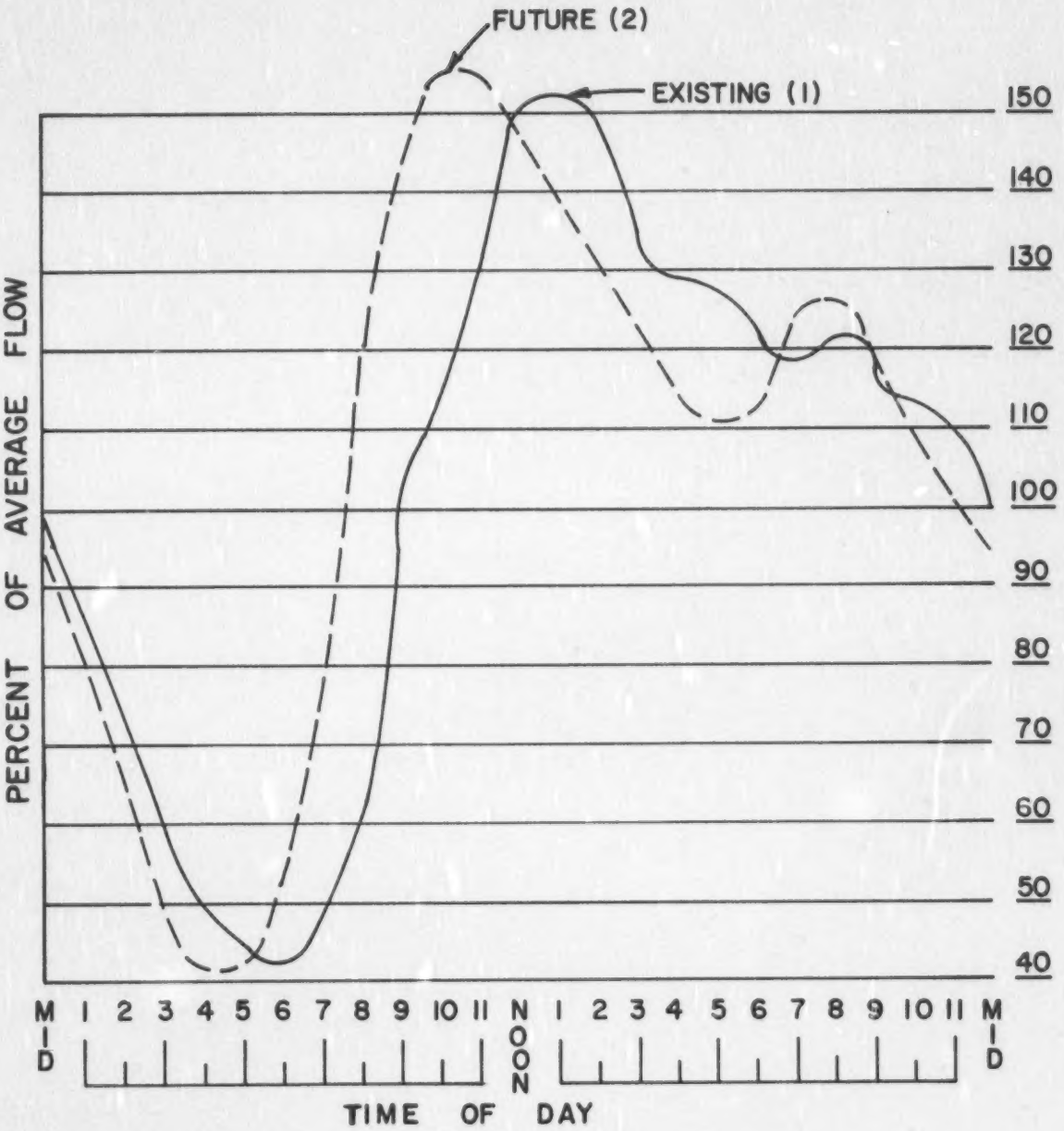
After this step a new process flow diagram should be developed for the modified facilities. When agreement is obtained internally and with the influencing government agencies, then

final designs and plans can be initiated. These diagrams will serve well in the preparation of operating and maintenance manuals and the training of personnel. Example diagrams are attached.

Conclusion

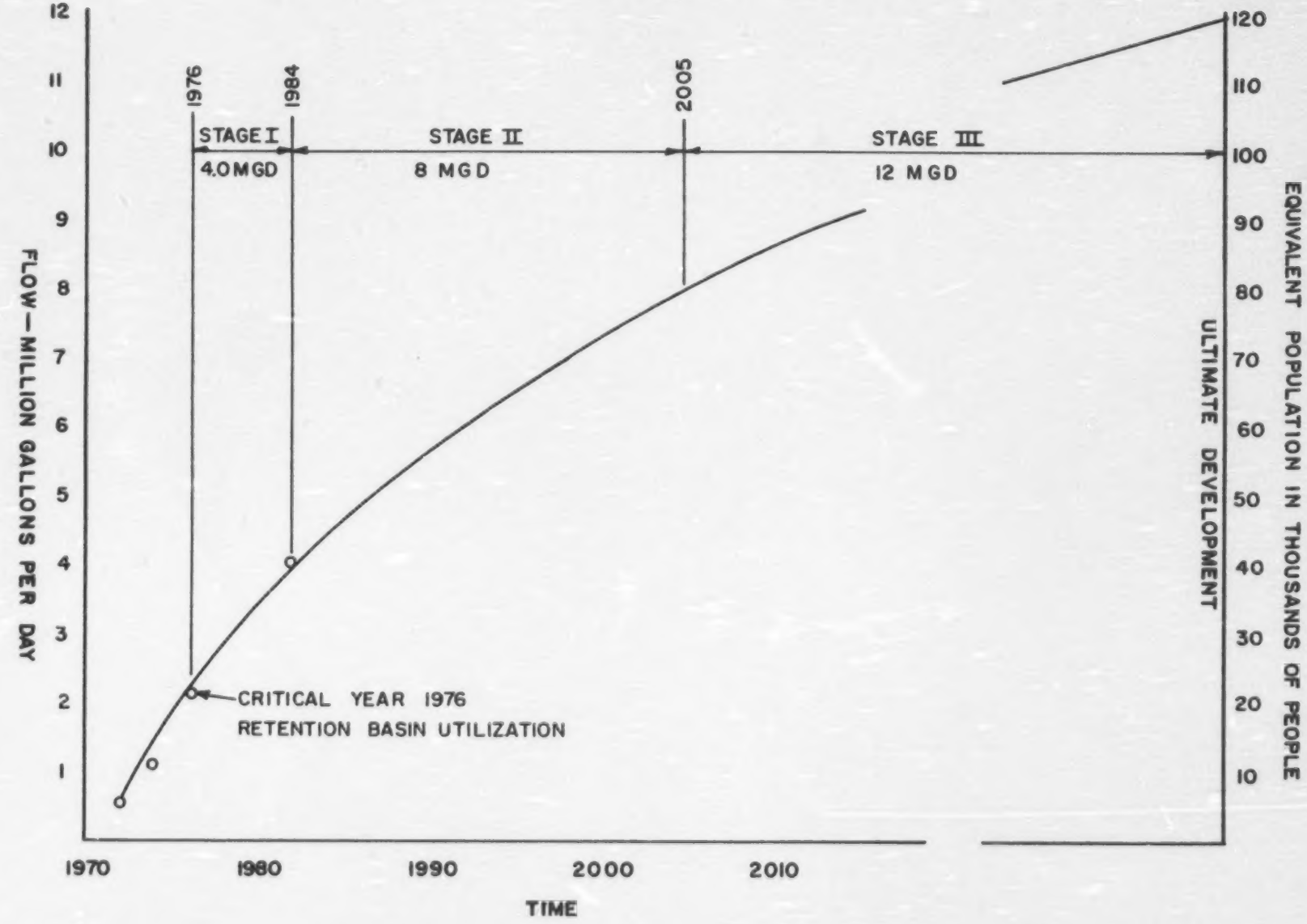
When guidelines, such as those described above, are followed, you can expect a surprisingly low cost for additional treatment capacity and higher quality effluent.

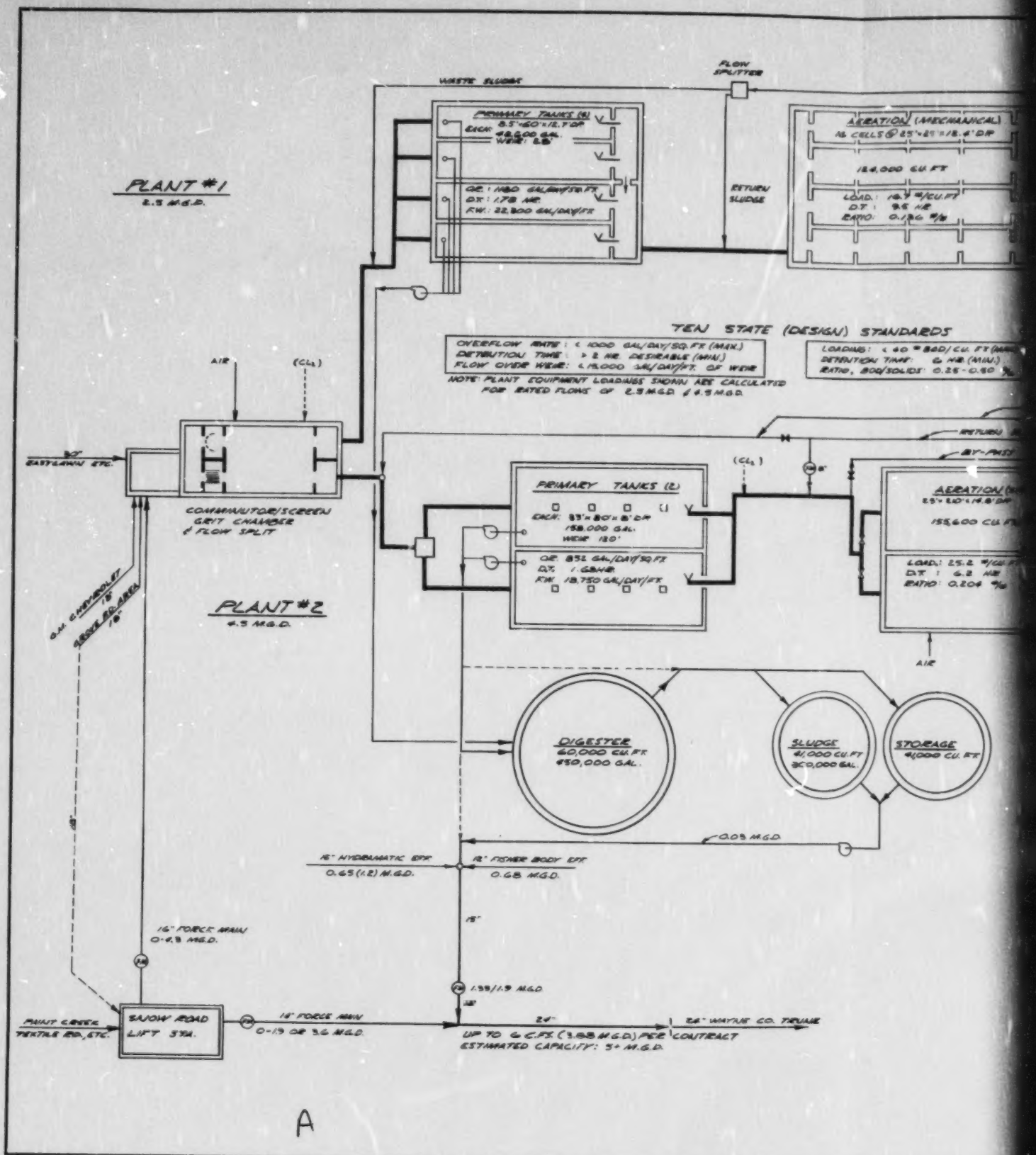
DIURNAL FLOW VARIATION



1 - FLOW BASED ON NO. OF PRESENT SEWER CONNECTIONS.
2 - FLOW BASED ON PREDICTED POPULATION DENSITY.

POPULATION & FLOW PROJECTIONS





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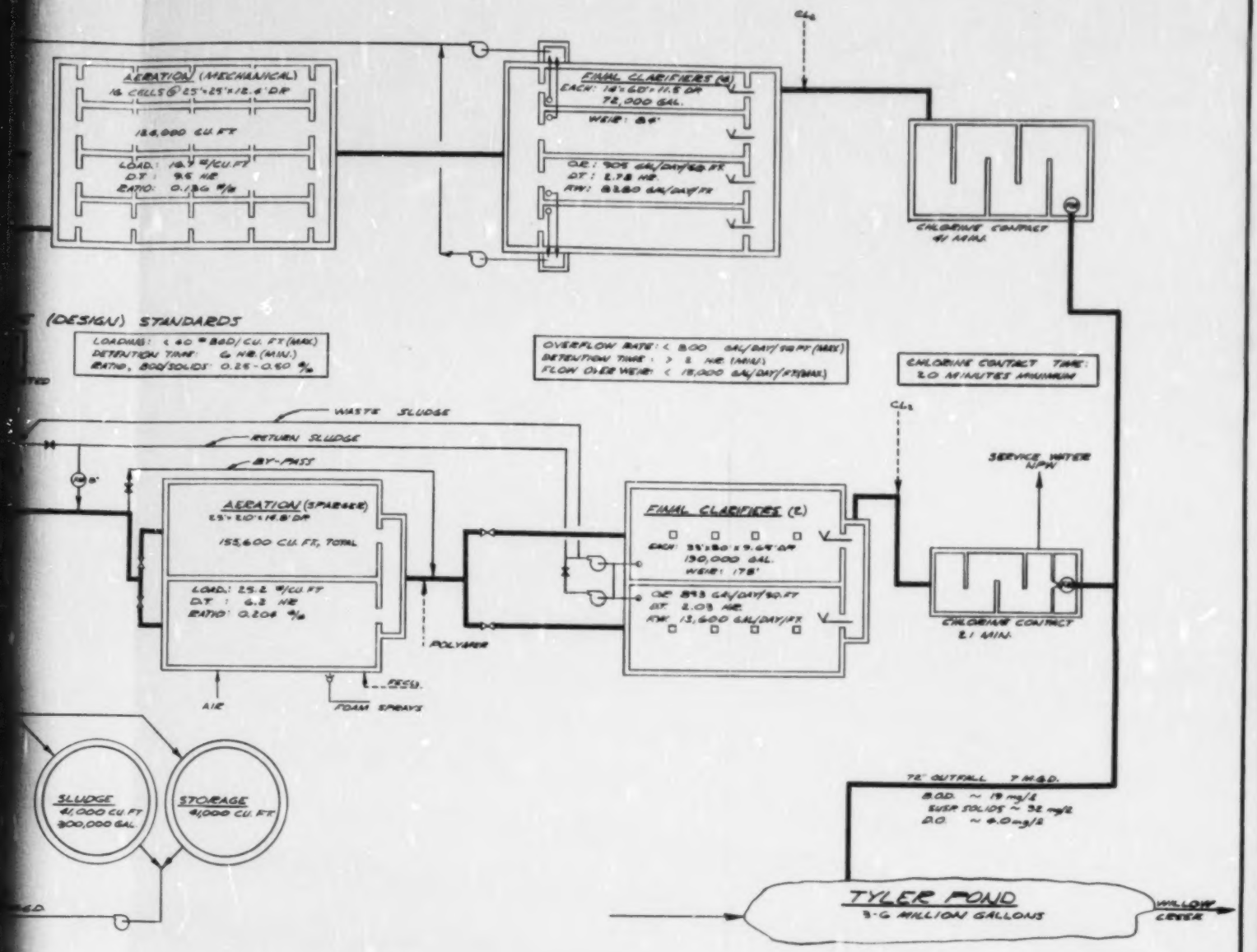
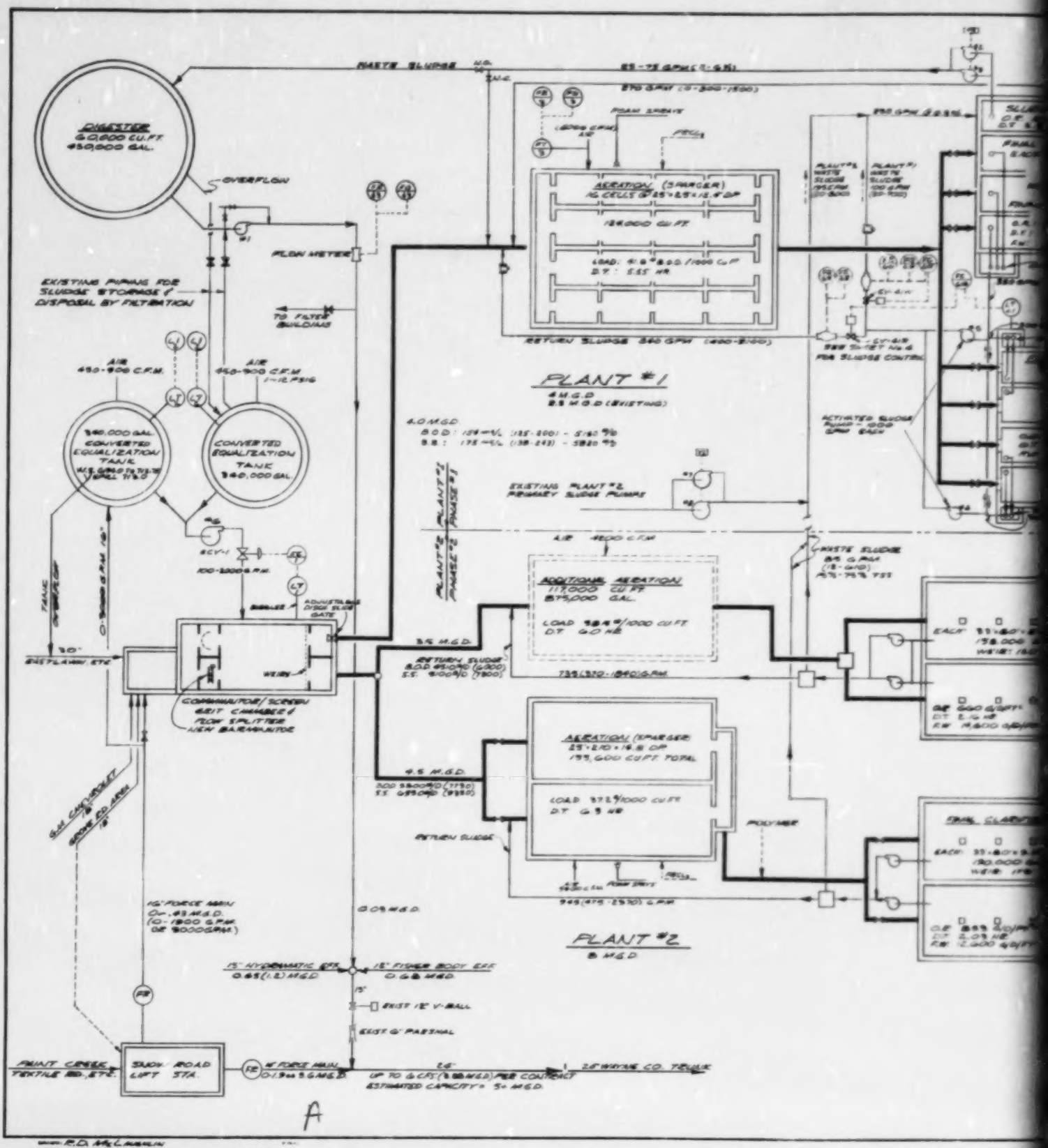


WATER QUALITY STANDARDS (WILLOW CREEK)

PRESENT:	
B.O.D$_5$	5.5 mg/l
ANTICIPATED: (1974)	
B.O.D$_5$	4.0 mg/l
SUSPENDED SOLIDS	15.0 mg/l
DIS. OXYGEN	5.0 mg/l
AMMONIA	0.5 mg/l
COLIFORM, FECAL	100/100 ml

B

ANDERSON, INC. ENGINEERS IAC MICHIGAN	SCHEMATIC FLOW DIAGRAM	YPSILANTI TOWNSHIP WATER POLLUTION CONTROL PLANT	JOB NO. 4537 DATE REVISED APR. 21, '71 SHEET NO. 1



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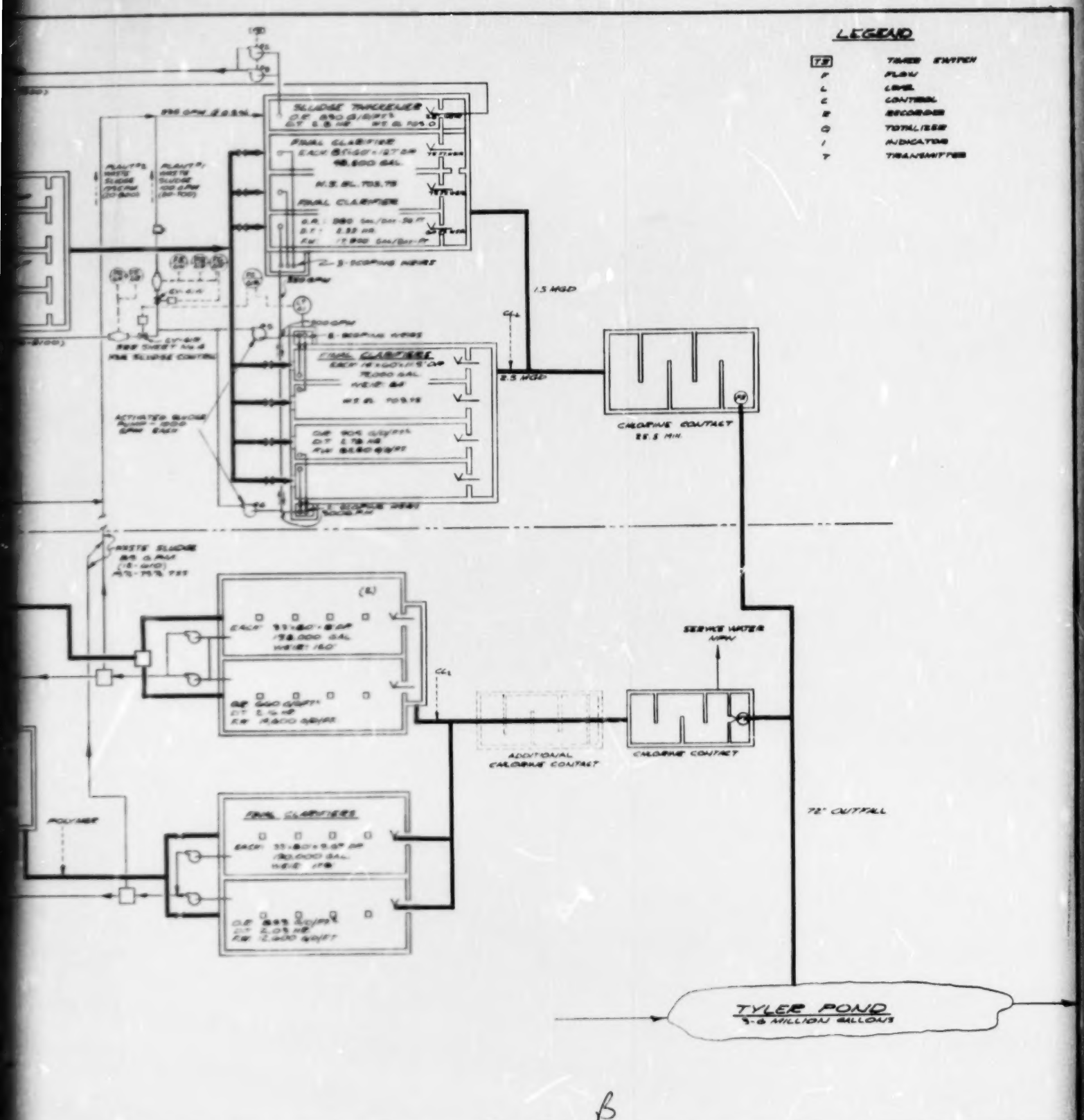

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ON & ANDERSON, INC.	TOWNSHIP OF YPSILANTI SEWAGE TREATMENT PLANT IMPROVEMENTS - PLANT No. 1	FLOW SCHEMATIC	JOB NO. 4557-01 SHEET NO. 3